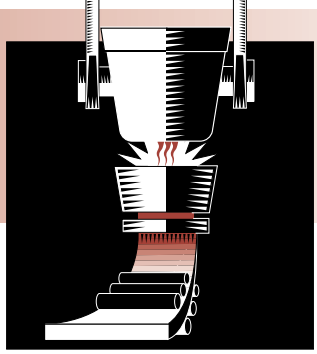
STEEL

Project Fact Sheet



Novel Direct Steelmaking by Combining Microwave, Electric Arc, and Exothermal Heating Technologies

Benefits

- Potential energy savings of 25% from the elimination of sintering and coking in steelmaking, and the replacement of BF and BOF with the more efficient combination of microwave, electric arc, and exothermal heating
- Significantly reduced energy and water consumption
- Reduction of SO_x and NO_x emissions

Applications

A combination of microwave, electric arc, and exothermal heating technologies may replace conventional steelmaking by producing molten steel directly from a shippable agglomerate consisting of iron ore concentrate, coal, and fluxing agent without the intermediate steps of coking, sintering, BF ironmaking, and BOF steelmaking. This technology has the potential to satisfy molten steel production demands of both integrated steel mills and minimills.

New technology may replace conventional steelmaking resulting in significant energy and operating cost savings while reducing emissions

Direct steelmaking through the combination of microwave, electric arc, and exothermal heating is a revolutionary change from current steelmaking technology. This technology will produce molten steel directly from a shippable agglomerate, consisting of iron oxide fines from ore concentrates, powdered coal, and fluxing agents such as ground limestone. This technology is projected to eliminate many current intermediate steelmaking steps, such as coking, sintering, blast furnace (BF) ironmaking, and basic oxygen furnace (BOF) steelmaking. This technology will provide the flexibility to enable iron oxide use in modified steelmaking electric arc furnaces. In addition, iron oxides from scrap and waste could be utilized in a similar manner as the iron ore concentrates. Iron bearing wastes such as sludges, slags, and dusts are seen as supplemental feedstock to recycling furnaces using this technology.

This technology has the potential to (a) save up to 25% of the energy consumed by conventional steelmaking, (b) reduce the emission of SOx and NOx, (c) substantially reduce waste and emission control costs, (d) greatly lower capital cost, and (e) considerably reduce steel production costs.

Photograph of MTU Bench-Scale Microwave EAF

MTU's bench-scale microwave electric arc furnace.

Novel Direct Steelmaking by Combining Microwave, Electric Arc, and Exothermal Heating Technologies (Continued)

The process is based on the capability of microwaves to heat the agglomerates to temperatures sufficiently high for the rapid reduction of the iron oxide component (crushed and ground iron ore) by the coal. The products are then heated to steelmaking temperatures by the electric arc, assisted by the exothermal reaction of coal with oxygen.

This project will involve steel companies (U.S. Steel, Rouge Steel, ACME Steel, and INMETCO, a recycler of metal bearing wastes), equipment suppliers (Cober Electronics, Inc., a microwave equipment company), an engineering firm (Techint Technologies, Inc.), an iron ore mining company (Cleveland-Cliffs Iron Company), and university researchers and faculty (MTU), to develop a conceptual design that is technically, economically, and environmentally sound and applicable to industry.

Project Description

Goal: To assess the utilization of a new direct steelmaking technology that combines the use of microwave, electric arc, and exothermal heating to produce molten steel directly from a shippable agglomerate, consisting of iron oxide fines, powdered coal, and fluxing agents such as ground limestone.

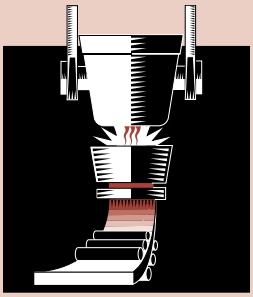
The objectives associated with this goal are as follows: (a) generate a solid base of technical, marketing, economic, and policy data, (b) develop energy, environmental, and economic targets, (c) more definitively assess opportunities and barriers, (d) accumulate knowledge and experience for defining direction for future development, and (e) promote learning and training of students.

This is a two-year project with Michigan Technological University the recipient of the award.

Progress and Milestones

The work will be accomplished under the following tasks:

- Project Start Date, September 2001.
- Task 1. Direct Steelmaking Tests and Technology Assessment.
- Task 2. Theoretical Flowsheet Development.
- Task 3. Evaluation of Equipment, Supplies, and Worker Environment.
- Task 4. Evaluation of Steel Company and Supplier Company Interaction and Logistics.
- Task 5. Energy and Environmental Assessments.
- Task 6. Marketing and Economic Assessments.
- Task 7. Evaluation of Policies, Regulations, and Affected Agencies.
- Task 8. Project Management and Reporting.
- Project End Date, September 2003.



Project Partners

Michigan Technological University, Institute of Materials Processing
Houghton, MI
(Principal Investigator)

ACME Steel Company
Riverdale, IL

Cleveland-Cliffs Iron Company
Cleveland, OH

Cober Electronics, Inc.
South Norwalk, CT

International Metals Reclamation Company, Inc. (INMETCO)
Ellwood City, PA

Rouge Steel Company
Dearborn, MI

Techint Technologies, Inc.
Coraopolis, PA

United States Steel Corporation
Pittsburgh, PA

For additional information, please contact:

Simon Friedrich
Office of Industrial Technologies
Phone: (202) 586-6759
Fax: (202) 586-7114
simon.friedrich@ee.doe.gov
http://www.oit.doe.gov/steel

Scott (Xiaodi) Huang
Michigan Technological University
xihuang@mtu.edu
Phone: (906) 487-1822
Fax: (906) 487-2921

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov. Visit our home page at www.oit.doe.gov.

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

June 2002